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(54) IMPROVEMENTS RELATING TO THE LINING OF PIPELINES AND PASSAGEWAYS

(71) We, TRIO ENGINEERING INC., a Liberian Company, of 80, Broad Street, Monrovia, Liberia, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the lining of pipelines and passageways.

It is known to line pipelines and passageways by means of a tubular liner which comprises a flexible, resin absorbent material using a method which comprises soaking the material in resin and allowing or causing the resin to cure whilst the liner is held in position lining the pipeline or passageway so that a hard abrasion resistant lining for the pipeline or passageway is formed. The absorbent material may, in addition to acting as a carrier for the resin, also act as a member rendering ductility and impact resistance to the lining. This method is suitable for the lining of a large number of pipelines and passageways, but because the resin shrinks upon curing, there are a number of lining applications where the method is not acceptable. One such application is the lining of gas pipes because if the lining shrinks away from the pipe wall, the gas tends to track along the clearance, which may be quite small, and this is unacceptable from a safety point of view. There are however many gas pipes (mainly underground gas mains) in need of lining because of age, fracture, leaks and so on, and the present invention is concerned with providing a lining for a pipeline or passageway which will be free of the above-mentioned disadvantage.

According to the invention there is provided a method of lining a pipeline or passageway with a tubular liner which, when unstressed, is of stable circular section form, but which is sufficiently flexible to have an axial section thereof deflected inwards to a deflected out of circular condition so that the effective overall sectional dimensions of the liner are reduced, the method including deflecting the liner to the deflected, out of circular condition, placing the liner in the pipeline or passageway whilst it is held by a holding means in the said deflected, out of circular condition and releasing the hold of the holding means when the liner is in position in the pipeline or passageway and allowing or causing the liner to return towards the circular condition, said liner being slightly oversize in relation to the size of the pipeline or passageway in the unstressed condition so that in returning to the circular condition in the pipeline or passageway, the liner becomes forced against the pipeline or passageway.

The invention also provides an adaptation of the method as aforesaid wherein the liner is stable in an out of circular condition and when in the pipeline or passageway it is forced to a circular condition in which it is also stable and remains forced against the pipeline or passageway and the holding means is not used. As an example of this adaptation, the liner may be of, or essentially of, a plastics material which is formed in the out of circular condition, and can have its shape changed, by for example the application of heat pressure, or mechanical force, to a stable circular condition. Again, in this method the circular form of the liner is slightly oversize in relation to the pipeline or passageway to cause it to become forced against the pipeline or passageway.

In either case, the liner becomes firmly 'wedged' against the pipeline or passageway, preventing the formation of clearances along which a medium such as gas can 'track' as explained herein.

The flexibility of the liner is preferably such that it will conform to small irregularities of the surface which it lines.

In one example of the first aspect of the invention, the holding means may be in the form of a tubular sleeve of plastics material which is placed over the liner in deflected condition and is provided with a tear line extending axially thereof which can be easily torn to allow the liner to move towards the circular condition.

In another arrangement there is a fuse wire along a line extending axially of the sleeve, so that on igniting the fuse wire it burns along the line rupturing the sleeve to allow the liner to move towards the circular condition. This sleeve conveniently will be of an abrasion resistant material which also has the characteristic of low co-efficient of friction so that it facilitates the pulling of the liner, with the sleeve thereon, into the pipeline or passageway to be lined without the sleeve becoming fractured in the process. This is important because these liners and sleeves may be made in very long lengths.

An alternative form of holding means is a tape which is secured to the liner outer surface along two axial regions bridging the deflected portion, such tape also having a tear line or fuse extending axially between said two axial regions so that the tape can be torn or ruptured to release the hold exercised on the liner by the tape.

In another arrangement, which is suitable for small diameter liners the holding means may be a former which is placed inside the liner and through which a medium is applied to the clearance space between the former and liner, to draw the liner onto the former and into the deflected condition until the former and liner are in place in the passageway when the vacuum is released enabling the liner to move towards the circular condition. The said former may be of a semi-rigid foam material such as polyurathane foam.

The liner may be of a plastics material having a plastic memory such as polypropylene or polyethylene, and it may be backed by a reinforcing fabric if desired. It is preferably constructed from a flat web of the material curved into circular form and the abutting longitudinal edges joined. The invention also applies to the insertion of short lengths of liner tube such as would internally cover joints in pipes. A suitable material for this application is sold under the name MACROFIL.

According to a preferred feature of the invention the passageway to be lined is at least partly, and preferably completely filled with liquid prior to insertion of liner, of liner and holding means, and the liner, or liner and holding means as an assembly, is selected so as to have as close a specific gravity to the liquid as possible.

This is to ensure that whilst the liner, or liner and holding means assembly, as it is inserted in the passageway, will be buoyantly supported on or in the liquid, minimizing friction between the liner, or liner assembly anl the passageway surfaces, or indeed keeping the liner or liner assembly out of contact with such surface altogether. The liquid is removed before the liner is moved towards the circular condition. The liquid conveniently will be water.

The invention also provides a pipeline or passageway lined in accordance with any method of the present invention.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawing, wherein:—

Fig. 1 is a perspective view of part of a liner usable in one method according to the invention;

Fig. 2 is a perspective view of part of a sleeve usable with the liner of Fig. 1;

Fig. 3 is a perspective view of part of a tape usable with the liner of Fig. 1;

Fig. 4 is a sectional view showing the liner and sleeve of Figs. 1 and 2 in a pipeline or passageway to be lined, the liner being shown in the out of circular deflected condition;

Fig. 5 is a sectional view showing the liner and tape of Figs. 1 and 2 in a pipeline or passageway to be lined, the liner being shown in the out of circular deflected condition;

Figs. 6 and 7 are views similar to Figs. 4 and 5 showing the liner in the final position in the passageway;

Fig. 8 is a perspective view of part of a liner usable in a method of another embodiment of the invention;

Fig. 9 is a sectional view showing the liner of Fig. 8 in a pipeline or passageway;

Fig. 10 is a view similar to Fig. 9 showing how the liner of Fig. 9 lines the pipeline or passageway;

Fig. 11 is a sectional view of a former usable in a holding means when in position in a liner as shown in Fig. 1;

Fig. 12 is a sectional view similar to Fig. 11, but showing how the liner is held in the out of circular, deflected condition by the former, the view also showing the liner and former in the passageway to be lined; and

Fig. 13 shows in section the passageway shown in Fig. 12, with the liner in position lining same.

Referring to the drawings, in Fig. 1 there is shown a lining for a pipeline or passageway, such lining comprising an inner layer of a plastics material 10 and an outer covering of a fabric 12. The liner is a circular tube of stable form. That is to say, it will not collapse when free standing, but is of sufficient flexibility to enable it to be formed to the deflected condition shown in Figs. 4, 5 and 12 in which an axial portion is inwardly deflected thereby to make the lining out of circular and to reduce the overall sectional dimensions of the liner. The liner tube 10 may be of plastics material such as polypropylene or polyethylene which has a plastic memory.

In Fig. 2 there is shown a liner sleeve 14

of a much thinner material and which is much more flexible than the liner of Fig. 1. The sleeve 14 is of a plastics material such as polyurethane, with embedded fibrous material reinforcement as desired, and is such as to be abrasion resistant, and also as to have a smooth surface finish so that it will have a low co-efficient friction with the pipeline or passageway which is to be lined, to minimise friction between the sleeve and passageway surface as the assembly is being inserted in the passageway. Fig. 3 shows a tape which may be of the same material as sleeve 14, the tape being indicated by reference numeral 16. Each of the sleeve 14 and tape 16 is provided with a line 18 and 20 of weakening or an ignitable fuse wire whereby the sleeve 14 and tape 16 can readily be axially and longitudinally torn or ruptured.

In order to line a pipeline or passageway indicated by reference numeral 22 in Figs. 4 and 5, the liner 10/12 is deflected to the condition shown in Figs. 4 and 5, in one embodiment, sleeve 14 is passed over the deflected liner to hold it in deflected condition as shown in Fig. 4, and the composite assembly is pulled into the pipeline to be lined. Fig. 5 shows how the tape 16 is used to hold the liner 10/12 in deflected condition. The tape is glued to crest regions 24 and 26 of the liner which extend axially thereof and have the deflected portion of the liner therebetween. The tape 16 may be attached by means of adhesive. In order to cause the liner 10/12 to take up a position lining the pipeline or passageway 22 from the Figs. 4 and 5 positions, it is simply a matter of tearing or rupturing (by igniting the fuse wire where provided) the sleeve 14 axially on the one hand along line 18, or tetaring or rupturing (by igniting the fuse wire where provided) the tape 16 longitudinally along its line 20 on the other hand. The material of the line 10/12 is such that the liner moves outwardly to the unstressed condition until it engages the wall of the pipeline or passageway 22. The liner 10/12 is made to be of such diameter as to be oversize in relation to the inner diameter of the pipeline or passageway 22. This means that as the liner 10/12 freely expands towards the circular position showin in Fig. 1, there may remain a small tuck 26 as shown in Figs. 6 and 7 in the liner. This is eventually forced to the position shown in full lines in Figs. 6 and 7 by any suitable means such as air under pressure or by means of the pasage of a pig through the interior of the liner. This tuck 26 in effect goes over centre and the result is that the liner is held firmly pressed against the interior surface of the pipeline or passageway and in fact is in compression by virtue of its position. The grip of the liner on the inner surface is excellent and the liner is held in position by a wedging type action.

In the arrangement shown in Figs. 11, 12 and 13, a former 30 of the sectional shape shown, and equal in length to the liner 10, 12, is inserted in such liner prior to placement of the liner and former assembly in the passageway to be lined. The former is semi-rigid material such as polyurethane foam so that it can be coiled and will bend with bends in the passageway as former and liner assembly is inserted into such passageway. The former has a central hole 32 which is closed at one end, and a plurality of radial passageways 34 from hole 32 to the outside of the former and when the liner surrounds the former as shown in Fig. 11, there are clearance spaces 36 between the former and liner. Before the assembly of former and liner is placed in the passageway, the ends of the clearance spaces 36 are sealed, and then a vacuum is applied to the hole 32 which draws air out of spaces 36. This has the effect of deflecting the liner to a stressed, deflected condition as shown in Fig. 12, in which the liner conforms to the former shape. The assembly is inserted into the passageway in this condition until in the desired position, when the vacuum is released, and pressure air supplied along hole 32 if desired, whereupon the line moves towards the circular condition and, as explained herein, lines the passageway, and the former is withdrawn. The liner may be placed finally in the position lining the passageway in the same manner as described in relation to Figs. 6 and 7. This method of the invention is very suitable for small diameter liners.

The wedging action of the liners against passageways which they line is extremely desirable for the lining of pipelines and passageways which have to carry medium such as gas, because it is easy to make connections into the interior of the liner through the pipeline or passageway wall and the danger or cracking of the liner and pipeline or passageway wall is minimized. The liner as will be appreciated should only be slightly oversize in relation to the pipeline or passageway to be lined as otherwise the liner will be formed with permanent folds 26 which cannot be removed. If the liner 10/12 is of appropriate material, it will deflect in accordance with any slight irregularities or projections in the interior from the passageway or pipeline.

Instead of using a holding arrangement such as is illustrated in Figs. 2 and 3 whilst the liner is placed in the pipe in deflected condition, the objective of the invention can be achieved by forming the liner to the configuration as shown in Fig. 8 in which the liner is stable, and then after such liner has been positioned in the pipeline or

passageway as shown in Fig. 9, it is then deflected to the circular condition shown in Fig. 10 lining the pipeline or passageway and it is so deflected i.e. under the action of heat pressure and/or mechanical force as to be stable in the Fig. 10 condition and held under compression because of the wedging action referred to above between the liner and the pipeline or passageway wall.

Where the sleeve 14 or the tape 16 is adapted to be torn along line 18 or 20 when the liner is in position, the sleeve or tape can be provided with a tear wire which can be pulled, or, as alternatives, cutting means can be passed along the inside of the deflected portion of the liner so as to slice through the tape or sleeve, or the tape or sleeve may simply be burst by pressurising the inside of the liner. Any other suitable means for releasing the hold of the holding means on the liner can be employed, and the holding means may take the form of spaced bands or tape or coils of filament.

Although the liner, or the liner and holding means as an assembly, of any of the embodiments described can be placed in a passageway when empty, and for such application the material of the liner, or liner assembly, which contacts the passageway during the pulling in operation should be as abrasion resistant and have as low a coefficient of friction with the passageway surface as possible, it is preferred that the passageway to be lined is at least partially filled, and preferably completely filled with a liquid prior to insertion of the liner or liner assembly, and that the liner or liner assembly be chosen to have a specific gracity, which is as near that of the liquid as possible. By such means the liner or liner assembly can be made to be buoyantly supported on, or in, the liquid as it is being inserted in the passageway, so that it will be kept out of contact, or excessive abrasive contact with the passageway surface until it is in position finally lining the passageway. The liquid is removed prior to the placement of the lining in the stressed condition, but during insertion of the liner or liner assembly, liquid may be allowed to enter the inside of the liner.

WHAT WE CLAIM IS:—

1. A method of lining a pipeline or passageway with a tubular liner which, when unstressed, is of stable circular section form, but which is sufficiently flexible to have an axial section thereof deflected inwards to a deflected, out of circular condition so that the effective overall sectional dimensions of the liner are reduced, the method including deflecting the liner to the deflected, out of circular condition, placing the liner in the pipeline or passageway whilst it is held by a holding means in the said deflected, out of circular condition and releasing the hold of the holding means when the liner is in position in the pipeline or passageway and allowing or causing the liner to return towards the circular condition, said liner being slightly oversize in relation to the size of the pipeline or passageway in the unstressed condition so that in returning to the circular condition in the pipeline or passageway, the liner becomes forced against the pipeline or passageway.

2. A method according to Claim 1, wherein the holding means is in the form of a tubular sleeve which is placed over the liner in deflected condition and is provided with a line along which the sleeve can be cut, torn or ruptured extending axially thereof, to allow the liner to move to the circular condition.

3. A method according to Claim 2, wherein the said line is defined by a fuse wire which can be ignited and will burn along said line thereby to rupture the sleeve.

4. A method according to Claim 1, wherein the holding means is a tape which is secured to the liner outer surfaces along co-axial regions bridging the deflected portions, such tape having a line along which the tape can be cut, torn or ruptured extending axially thereof to allow the liner to move to the circular condition.

5. A method according to Claim 4, wherein the said line is defined by a fuse wire which can be ignited so as to burn along said line and thereby to rupture the tape along said line.

6. A method according to Claim 1, wherein the holding means is a former which is placed inside the liner and through which a vacuum is applied to the clearance space between the former and the liner, to draw the liner onto the former and into the deflected condition in which the former and liner can be inserted in the passageway, and subsequently releasing the vacuum to enable the liner to move to the circular condition.

7. A method according to Claim 6, wherein the former is of a semi-rigid foam material such as polyurethane foam.

8. An adaptation of the method as claimed in Claim 1, wherein the liner is stable in an out of circular condition and when in the pipeline or passageway it is forced to a circular condition in which it is also stable and remains forced against the pipeline or passageway and the holding means is not used.

9. A method according to any preceding claim wherein the liner is of a plastics material having a plastics memory, such as polypropylene or polyethelene.

10. A method according to Claim 9 wherein the liner is backed by a reinforcing fabric.

11. A method according to any preceding Claim wherein the passageway to be lined is at least partly filled with liquid prior to the insertion of the liner, or the liner and holding means assembly, and the liner or liner and holding means assembly is selected so as to have as a close specific gravity to the liquid as possible to ensure that whilst the liner or liner and holding menas assembly, as it is inserted into the passageway, will be buoyantly supported on or in the liquid.

12. A method according to Claim 11, wherein the liquid is water, and the passageway is completely filled.

13. A method of lining a pipeline or passageway substantially as any of the embodiments described herein or with reference to the accompanying drawings.

14. A pipeline or passageway lined in accordance with a method of any of the preceding Claims.

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1580438 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

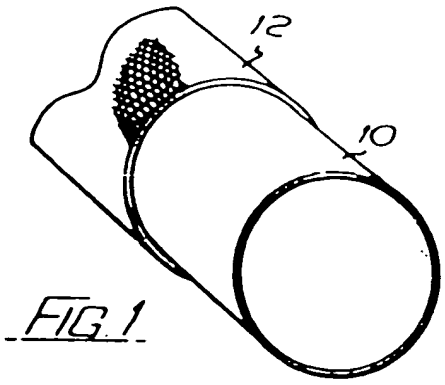

FIG. 1

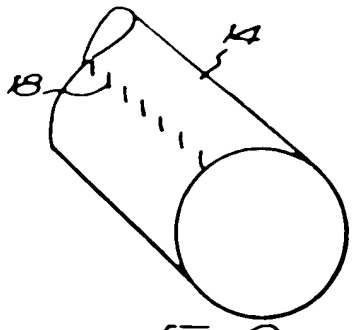

FIG 2

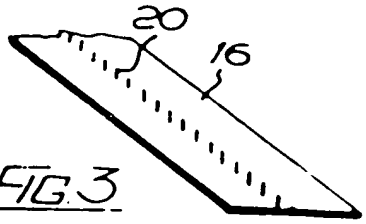

FIG 3

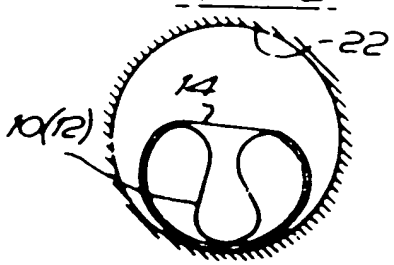

FIG. 4

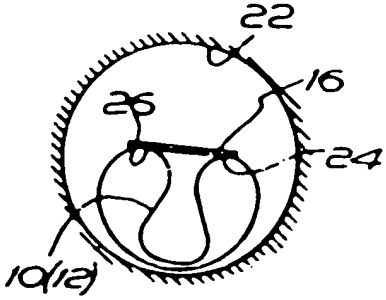

FIG 5

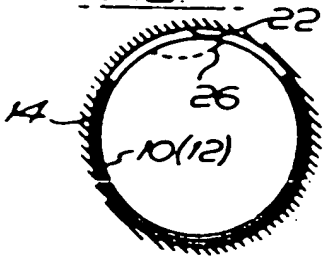

FIG. 6

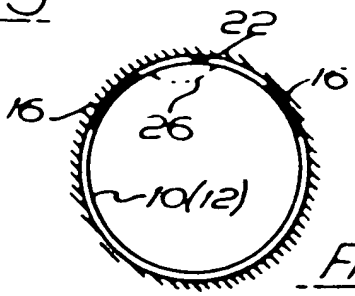

FIG 7

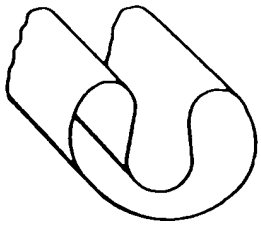

FIG. 8

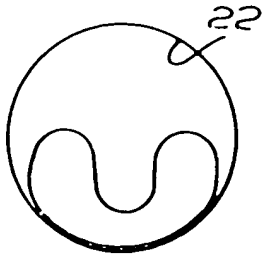

FIG. 9

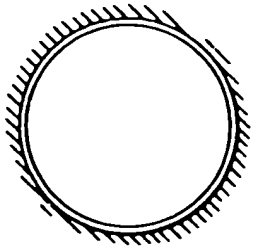

FIG. 10

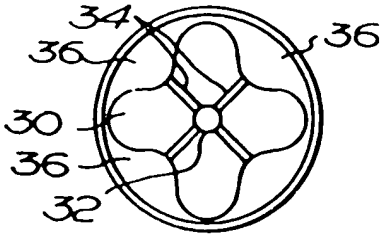

FIG. 11

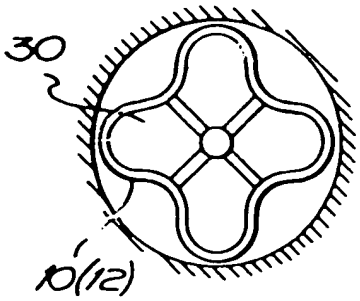

FIG. 12

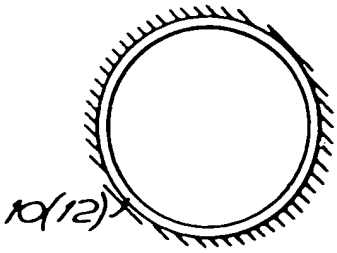

FIG. 13